Nor can the search for this locality be left wholly to private enterprise. Much depends upon the results of coast surveys, which are but a trifling expense to governments having surveying vessels ready equipped, and a great deal also depends upon the spirit, in which the Powers who rule the countries, grant concessions for the use of their territory: besides, a great work which will affect the commerce of almost every maritime nation, must be conducted with the support and under the guidance of the first Maritime Powers, and it is therefore their interest to assist in the settlement of the question.

IX.—*On the Causes of the Mild Winter-Temperature of the British Islands.* By THOMAS HOPKINS, Esq., M.B.M.S., Vice-President of the Manchester Literary and Philosophical Society, &c.

Read June 22.

MANY well-informed persons believe that the temperature of oceanic currents materially affects, and to a considerable extent determines, the climates of countries near to which they flow; and this belief probably rests on the supposed influence of the warm Mexican Gulf-stream on the climate of the north-western portion of Europe. Such an opinion is to be found in the works of eminent men, advanced in a way which shows that the writers believed it to be generally entertained; and, without producing evidence, they assumed it to be well founded. The president of the British Association, in his opening speech at Hull, distinctly said that the comparatively mild winter-temperature of this country was due to the warming influence of the Gulf-stream; and he ventured a speculation as to the probable effect of an opening being made by nature in Central America, which should allow the tropical ocean current that now runs through the Caribbean Sea into the Gulf of Mexico to pass farther west, and enter the Pacific ocean. Should such a change occur, he represented that this country would be very much colder than it is, and that its winters would become as severe as those of the opposite coast of the Atlantic.

Considering the vague notions that have been entertained respecting meteorological influences on climate, it is not very surprising that such an effect should be attributed to the great warm current which undoubtedly flows from the northern tropic into the Atlantic. The temperature of the part of the ocean where the stream enters it is high for the latitude, and is evidently rendered so along a certain belt near the American coast, by the

Gulf-stream. And, apparently, without making any attempt to ascertain what effect such a temperature of the ocean can have on contiguous countries, a conclusion seems to have been generally arrived at that the Gulf-stream must be the cause of the warm winter climate of those islands which are situated so remote from it! The subject has been treated as one resting on simple and well-known facts—those facts being assumed to have the relation of cause and effect. The Gulf-stream, which enters the Atlantic in the winter, is warm, and the British Islands and other parts of north-western Europe have warm winters; and as no other cause was known to account for the warmth of these winters, the Gulf-stream, though thousands of miles distant, was presumed to be the cause. But if, as alleged, a warm sea materially increases the temperature of adjoining countries in a cool latitude, it would always produce that effect, unless counteracting causes interfere; and we should find that, wherever there was a warm sea there would be a warm winter climate in the country contiguous to it: and it would naturally follow that the effect would be great in proportion to the height of temperature of the water. Is this, however, the case, even with the water of the Mexican Gulf itself, or of the stream that flows immediately from it towards the north?

The water that passes through the Caribbean Sea into the Gulf of Mexico comes from near Africa, and is therefore long exposed to a tropical sun, and much heated. It is detained in a large and almost enclosed space, much of which is within the northern tropic, until its temperature is further raised, attaining at last the height of from 86° to 100° of Fahrenheit, which may be considered the highest temperature that is reached by any large body of water in the ocean. But on inquiry being made, we find that this very warm inland sea does not produce a corresponding effect on adjoining countries. Texas, Louisiana and Florida bound this sea on the north, and their winter climates are certainly not warmer than what belong to their latitudes; they, therefore, do not appear to be sensibly affected by the warm sea that is near them. This accumulated body of warm water finds an outlet in a channel between Florida and the island of Cuba, and through this channel the water, retaining its high temperature, rushes with considerable impetuosity.

The stream, passing northward between Florida and the Bahama Islands after the rate of five miles an hour, is said to be 52 miles broad opposite Cape Biscayo; and it passes along the coasts of the United States, being for a considerable distance parallel with them. By the time that it reaches the latitude of 28½° it is of the width of 59 miles, and, spreading as it proceeds, is found to be from 138 to 173 miles in breadth opposite Charlston, in lat.

33°, where the current runs from three to five miles an hour in the narrowest parts, and diminishes to one mile farther north. Now if a warm sea current could, by its contiguity, give considerable warmth to the land near to which it passes, or to the mass of the atmosphere over that land, we ought to have the northern coast of the Gulf of Mexico and the eastern coast of the United States, from the southern point of Florida to Cape Hatteras, rendered decidedly warm in the winter season by the Gulf-stream. The whole of this country, between the eastern coast of America and the Mexican Gulf, is flat and low, being little above the surface of the warm water that adjoins it on two sides, and therefore is as fully exposed to the influence of the water as land can be by its contiguity. But so far from this part of the country having a warm winter climate for its latitude, it is rather remarkable for its low temperature in that season, the growing cotton being often damaged by the frosts. It is said in Lizar's Atlas, that "In Georgia the thermometer sinks to 17°! and still further south, at New Orleans and Louisiana, the winter is occasionally severe. The prevalence of cold, so far south, is partly to be ascribed to the northerly winds, which, bursting forth in tremendous hurricanes, sweep along the vast plains, and carry the dominion of cold far into the southern countries." That is just the case! Atmospheric influences are sufficiently powerful to produce an opposite climate in the parts named, to that which we are told is caused by adjoining warm water.

In the meridian of Halifax the warm current is nearly 276 miles broad. Here it turns to the east, its western margin touching the extremity of the great Bank of Newfoundland. Throughout the whole of this course it is distinguishable by its temperature, which is, however, reduced as the stream flows on, spreading itself out in colder latitudes. From the Bank of Newfoundland the stream runs to the east; and Humboldt says "it continues to flow to the east and east-south-east still retaining part of the impulse. In the meridian of the Isles of Corvo and Flores, the most western of the Azores, it directs itself towards the Straits of Gibraltar, the island of Madeira, and the coast of Africa, and mixes with the equinoctial current." Thus it appears from Humboldt's account that this body of water, instead of running towards the north in this part of the ocean, and thus approaching the British Isles and Norway, does not extend beyond the latitude of 40° while passing eastward, but returns towards the south to complete its circuit by feeding the tropical current beyond Madeira, which runs to the Caribbean Sea.

But we have other evidence of the state of the Atlantic in this part. In Dove's chart of Isothermal lines of the atmosphere in the northern hemisphere for the month of January, the line of

mean temperature of 50° Fahrenheit is found in China over the 30th degree of latitude, from which it rises as it passes over the Pacific Ocean to the latitude of 45°. The same line of temperature descends as it passes over the land in America until it reaches the eastern side of the Mexican mountains near Texas in the latitude of 32°. It then passes over Texas, Louisiana, Mississippi, Alabama, and Georgia, near the Gulf of Mexico, the water of which, be it remembered, is not less than 86° of temperature, that is, 31° warmer than the land, to the town of Savannah on the Atlantic coast washed by the Gulf-stream. And the same line of temperature, 50°, while passing over the warm Gulf-stream near Savannah, and over the Atlantic Ocean, ascends gradually towards the north, but does not reach the latitude of 45° until it arrives at the western longitude of 25°, near the middle of the Atlantic. Thus the mean temperature of the month of January is found to be the same in about the same latitude over the two great oceans, the respective longitudes where this takes place being, say 170° west in the Pacific, and 25° west in the Atlantic oceans. The atmosphere, therefore, over the water, in the latitude of 45°, is as warm in the middle of the Pacific as in the middle of the Atlantic. Now no one supposes that the temperature of the air over the vast Pacific Ocean, in the part named, is determined by a warm Gulf-stream; and there is no good reason to presume that the temperature over the Atlantic is so determined. A nearer approach to uniformity of temperature throughout the year is always found over deep waters than over land, which, with the operation of similar meteorological influences, are evidently the causes that determine the temperature over the two oceans.

The influence of cold winds in reducing temperature has been shown this year in the parts of the United States that are near the Mexican Gulf. The 'New York Herald' of Feb. 12, 1854, states, that "on the 23rd of January the river Brazos, in Texas, froze strong enough to bear a horse. The mercury at sunrise on the 25th was 1°, on the 26th 0°, on the 27th 1° below zero, on the 28th 0°, and on the 29th 1°, and during this time a fierce wind blew from the north and north-east." NEW ORLEANS. "For 30 days we have been visited by almost uninterrupted frost. The ice remains in the streets; the portion melted by the sun during the day is again solidified at night." The 'San Antonia Texan' of the 24th January says, "The cold weather has lasted 32 days; the thermometer has been 14° below the freezing point." At NASHVILLE "The thermometer, on the mornings of the 23rd and 24th January, was down to zero, or below."

The intense cold in those parts was evidently produced by cold wind; but what gave rise to this wind? The newspaper writers do not put such a question. A subsequent account, however, in

the same paper, of the 20th February, gives the following information. In the 'Herald' of that date it is said, "A ship left Mobile, crossing the outer bar at 10 P.M. of the 5th February, and crossing the Gulf she encountered a continuous gale of wind from the southward and eastward, accompanied by heavy rain. Left Havana on the 9th, and experienced very severe weather from the northward and westward. From Havana we learn that the constant rainy weather is fast destroying all hopes of a large sugar crop from Cuba; the pressed cane will not dry." We here learn that there had been constant rainy weather in Cuba, whilst the cold winds were blowing over New Orleans and Texas; those winds were, therefore, blowing towards the part where heavy rains were destroying the sugar crops; and the rains appear to have continued up to about the 6th February in the Gulf of Mexico, and may be considered to have produced the winds from the north.

Many, though imperfect, accounts have been furnished of the temperature of the water of the ocean in that part of the Atlantic which lies between the British Islands, and the United States of America; but it may here suffice to give some particulars from the valuable Paper which was read to the British Association at Hull in the year 1853 by Dr. Scoresby. The Rev. Doctor collected registrations of the surface temperature of the northern Atlantic whilst passing from the tenth to the seventy-second degree of w. longitude, in a belt averaging 220 miles broad, and extending from the entrance of the English Channel to Long Island, proximate to New York. He divided this belt into six portions, and the three of these nearest to America present many curious facts connected with the meeting and interlacing of the Gulf-stream, and of the cold current which descends from the Arctic regions to Newfoundland, and then passes on both the east and west sides of that island towards the south. But it is the other half of this belt, nearer to Europe, in which we are interested, and respecting which we have more particularly to inquire. For, if the Gulf-stream raises the temperature of north-western Europe, and determines its winter climate in the way that has been so confidently asserted, it is through this portion of the Atlantic that it must operate. Our inquiry, however, relates more especially to the winter climate; and a separate account of the temperature of the water at that season in the eastern half of the belt of the Atlantic is not given in as full a manner as is desirable. The accounts furnished are from averages of thirteen voyages, three only of which were made in the winter; but from what is stated this does not appear to be of essential importance. The first three of the six divisions of the belt, including the portion between the tenth and fortieth degrees of longitude, is stated to "Exhibit for the most part a striking

degree of uniformity of character; for, as far at least as longitude 38° west, no particular in the difference of surface-temperature strikes us, except a gradual rising of the means within two degrees space from 52°-9 to 58°-7 (Fah.) during a descent in the mean latitude from 50° to 46° N. This is a rise of only 5°-8 of temperature, whilst passing southward through four degrees of latitude, and proceeding towards the Gulf-stream *through no less than twenty-eight degrees of longitude!*

In another place in the paper it is said that in this part of the ocean the surface-temperature was not found to descend below 50° in the winter passages, nor to rise in any part of the year higher than 66°. It is also stated that steering w. by s. from longitude 12° to 36° w., and in latitudes 50° to 46°, the observations indicated an increase of the surface-temperature of only about three-quarters of a degree for each degree of latitude for the winter, and one degree for the summer. This statement, therefore, does not show that the Gulf-stream warms the northern Atlantic in the winter to the east of 40° of west longitude, and that is the only part that could raise the temperature of Europe.

But on the American side to the west of the forty-second degree of longitude the doctor found that the cold Arctic current from the north interposed *before the warmer part of the Gulf-stream* near to America was reached. He says, "Beyond the meridian of 42°, where the cold current from the north becomes first decided, an increase of its prevalency gradually becoming more and more conspicuous is observed;" and he describes numerous stripes of cold water which were crossed between 42° and 52° w. "The greatest prevalence of the polar current that is found in this section is within the meridians of 46° and 52°." Thus it appears that between the longitudes of 42° and 52° the Gulf-stream coming from the south-west was entirely cut off from the north-eastern portion of this part of the Atlantic by cold streams from the north, leaving us at liberty to conclude that the warm water turned towards the Azores, as described by Humboldt. Dr. Scoresby therefore furnishes additional and tolerably conclusive evidence that the Gulf-stream does not go to that part of the Atlantic which is near North-Western Europe.

In the whole of the valuable paper from which the above extracts have been given, it is assumed that there are two currents in the northern Atlantic,—one, the Gulf-stream, coming from the south, and the other coming from the north; and all the secondary currents and strata which were encountered are attributed to the dynamical forces of these principal currents. But it has been shown in former papers that not only are winds the prime movers that create all the great currents of the ocean, but that wherever winds blow over it, the surface of the

water is disturbed by them ; and, when they are continued for a moderate time, that other currents are created which flow in the direction of the winds. Now, during the early part of the winter, west, south-west, and south winds prevail in the northern Atlantic ; and those winds must be presumed to create new surface-currents ; and any water that may be found in the neighbourhood of the British Islands, which has come from more southern latitudes, is likely to have been brought by the winds, and not to be branches of the Gulf-stream, as has been assumed, without adequate evidence to support the assumption. We are, therefore, authorised to infer that the warm winter climate of the north western part of Europe is not attributable to the Gulf-stream, which by its dynamical force flows from America by the Azores to northern Africa, but that it may be due to the moist south-western winds that generally prevail in the northern Atlantic.

The warming influence of a moist atmosphere is strikingly exhibited in the north-eastern part of America, extending across Davis' Straits and Greenland into the Arctic Ocean. The very cold and dry north-west wind that in the winter passes over the middle northern part of the continent of America cools its atmosphere down to a very low temperature. The isothermal line of 5° of Fahrenheit descends in the central portion of the continent to so low a latitude as 48° ; but in passing over Labrador the temperature rises rapidly, and in crossing Baffin's Bay the same isothermal ascends almost directly towards the north. It then crosses Greenland, still rising, and leaves that country in about 70° of latitude. It touches Spitzbergen in 78°, and further to the east reaches Nova Zembla ; in the whole of these more northern parts being apparently affected by the Atlantic winds. The temperature of January is thus shown to be the same in 48° of latitude over the interior of the continent of America—in 58° on the coast of Labrador—in 70° on the east coast of Greenland—and in 78° at Spitzbergen. Another winter isothermal line, that of 32°, is found over the continent in latitude 40°, but like the colder line just traced it rises in latitude as it proceeds eastward, and leaves Iceland in 64°, and further east it reaches about 69° of latitude. Thus the isothermal of 5° of Fahrenheit here rises, in the whole, through 30° of latitude ! and that of 32° of Fahrenheit ascends through 29° of latitude ! Now the rise to the north of both these lines of temperature is over the land of America in the first instance, and then over that part of the water of the ocean near America which flows from the north, known by the name of the cold Arctic current. The space that is included between these two isothermals is large, and for the greater part far remote from the locality which any one supposes the Gulf-stream to reach. But the moist southern winds of the Atlantic were found in all the

warmed parts, furnishing, through the process of condensation of vapour, fogs, and clouds; and much snow to Greenland, Iceland, and other places;—and to these winds and the vapour which they contain may be legitimately attributed the comparatively high temperature that is found over this portion of the surface of the globe.

The well-known great south-eastern current of the ocean, which flows from the Cape of Good Hope across the southern Atlantic to tropical America, is divided at Cape St. Roque, in about the latitude of 7° s., into two portions, one flowing into the Caribbean Sea, and finally becoming a part of the Gulf-stream already described, and the other running along the coast of Brazil to the south: this second part is said to approach the Straits of Magellan. But along the whole of the coast line of this part of South America, no one alleges that the winter climate of the locality is rendered warm by the contiguous warm water of the ocean. The temperature of the Brazilian coast is not so high as that of Africa in the same latitudes, and when a distance from the equator is reached, equal to that of the British Islands in the other hemisphere, the climate is not moist and warm like that of the north-west of Europe, but of an opposite character, being decidedly cool and dry. The most southern part of England is in the fiftieth degree of north latitude, and the eastern coast of Patagonia commences in about the fortieth degree of south latitude, extending 12° further to the south. Now along this line of 12° of latitude we find a winter climate the opposite of that which distinguishes the British Islands. It is throughout dry, and, speaking in general language, cold. The following is a specimen of the way in which this country is spoken of by writers who have examined it:—Captain FitzRoy says, "In July (the winter of the south) the climate of Rio Janeiro, in latitude 22°, is comparatively cool and pleasant. From Cape Corrientes, in latitude 38°, to Bahia Blanca, is a long and dreary line of coast. The most serious objection to the locality is the want of rain. Rain is seldom known during the three-quarters of the year, and even in the three winter months but little falls except on rare occasions. In winter, though the weather is sometimes searchingly cold, especially during southerly winds, the air is always elastic and wholesome."

But it may possibly be said that eastern Patagonia is part of a continent, and that the British Islands are insular. Yet it is not easy to see how that circumstance can account for the different climatic accompaniments of the two ocean streams. The statement made is that a stream of water passing from the tropics, and bearing a certain high temperature with it to land in regions outside the tropics, communicates that temperature to the land and makes the winter climate warm for the latitude. Now if that were true,

the eastern coast of Patagonia would be warm in the winter, which it is not, and therefore that part of the world presents evidence tending to disprove the doctrine that is here combated. Not only, however, the British Islands, but the whole north-western coast of Europe, including Norway, is moist, and, for the latitude, warm in the winter.

No account represents the warm southern ocean stream off South America as passing eastward, before it reaches its terminus near the Straits of Magellan, as the northern stream does off Newfoundland. The latter stream, on leaving the Gulf of Mexico, takes its departure from Cuba on the northern tropic and runs to the latitude of 40° north, when it turns to the east, enters a wide and deep ocean, and afterwards flows back to the south; but the Brazilian stream runs directly south from the highly-heated seventh degree of latitude, keeping always near the land until it reaches say the fifty-second degree; yet it produces no sensible effect on the climates of the countries whose shores it washes, whilst it is gratuitously assumed that the northern stream has great effect in parts so remote from where it is actually found, as the British Islands and Norway, which are separated from the stream by a wide and deep ocean! Brazil and Patagonia, like the part of the United States of America parallel with the Gulf-stream, show that the warm ocean current which runs along their coasts does not sensibly warm them in the winter season, and therefore we may confidently conclude that such a stream cannot warm parts more distant from it, like the British Islands, whose connexion with it is not proved.

Reasons have been given elsewhere for attributing the peculiarly warm and moist climate of the British Islands to *atmospheric* and not to *oceanic* influences. It has been shown that these islands are warm in the winter, considering their latitudes, because vapour from the south is extensively condensed in and about them, which condensation renders the air warm and the winter climate mild in this part of the world. It is quite possible that the warm Gulf-stream may to some extent raise the temperature of the Atlantic up to the latitude of 40°, and thus supply a little more vapour to be condensed in north-western Europe. This, however, is not what is advanced by those whose opinions are here combated, as, according to them, the Gulf-stream itself reaches north-western Europe, and its vicinity to the land is alleged to produce, by the ordinary influences resulting from contiguity, the warm climate—an opinion altogether unsupported by evidence. It may be remembered also that evaporation is a very cooling process, and to that process the water of the Gulf-stream is exposed in the wide expanse of the Atlantic, where, as the surface-water cools, it sinks, and warmer water rises to go through the same process.

But there are other reasons for believing that the climate of this

part of the world would continue what it is at present, supposing the temperature of the Atlantic to become hereafter entirely unaffected by the Gulf-stream. Oregon, New Albion, Vancouver's Island, and other parts of the north-western coast of America up to 60° of latitude, have warm winters like the British Isles and Norway, and it has never been asserted that the immense surface of the northern Pacific Ocean is warm beyond what is due to its depth and latitude. There is a current from Japan running into the northern Pacific, which may possibly produce some little effect on the temperature of the western part of this wide ocean; but no one has attributed the mild winter climate of the north-western coast of America to the warmth of the Japanese stream. This part of the world may, therefore, be said to present evidence against the supposed influence of the Gulf-stream.

But, in addition to the evidence furnished by the northern Pacific, there is another part of the world which shows that a warm winter climate, such as that of the British Islands, may be produced at a great distance from tropical regions, and where no one can imagine that it has been caused by a warm ocean current. This part is western Patagonia, Tierra del Fuego, and Cape Horn, extending from 40° to 54° of southern latitude on the west coast of South America. No warm oceanic current flows from tropical regions to these countries! On the contrary, a very cold current runs from them to a warm region, taking cold water near to the equator! That the extraordinary high winter temperature of Cape Horn and the other countries named is due, not to a warm adjoining sea, but to condensation of vapour, scarcely admits of dispute, as no cause for the warm climate but the condensation of vapour can be traced, and that is so abundant as fully to account for the warmth. In the increasing trade now carried on between Australia and this country, ships usually pass across the southern Pacific by Cape Horn to England. To accomplish this by the shortest route, navigators adopt the improved system of great-circle sailing and run far to the south, and there they find both an atmospheric and an oceanic current setting from the frigid region of Victoria land in nearly 70° of latitude to Cape Horn, Tierra del Fuego, and western Patagonia, which are within the latitudes of say 55° and 40°. The ocean current which washes these shores, therefore, flows from a cold to a warmer latitude, and cannot warm the land. But a wind blows not only from Victoria land, but also from New Zealand across the whole extent of the southern Pacific to Cape Horn and western Patagonia. Now this wind, passing over so great an extent of water, becomes as fully charged with vapour as is compatible with the temperature, and a large quantity of this vapour is found to be almost regularly and constantly condensed against the hills and mountains of the western side of the southern extremity of

America. Here it evidently produces the warm winter climate of this part of the world, which has so much surprised those who have remained in it during that season.

Attention has already been directed to this extraordinary meteorological region (see page 111 of 'Atmospheric changes,' &c.); but it may be well to give here short extracts describing it. Captain FitzRoy says: "The climate of western Patagonia is so disagreeable that the country is almost uninhabitable. Clouds, winds, and rain are continual in their annoyance. Perhaps there are not ten days in the year on which rain does not fall, and not thirty on which the wind does not blow strongly, yet the air is mild and the temperature surprisingly uniform throughout the year. The country is like the worst parts of Tierra del Fuego, a range of mountains half sunk in the ocean, barren to seaward, impenetrably wooded towards the mainland, and always drenched with the waters of frequent rains, which are never dried up by evaporation before fresh showers fall." . . . "As yet I have found no difference in Tierra del Fuego between summer and winter, excepting that in the former the days are longer and the temperature is perhaps 10 degrees higher."—Vol. ii., pages 142 and 390.

The strong winds which blow in this part extend to the Falkland Islands, which partake of the climate of Tierra del Fuego. Of these Captain FitzRoy says: "The winters are mild, the temperature being seldom so low as the freezing point. Wind is the principal evil at these islands; a region more exposed to storms, both in summer and winter, it would be difficult to mention. The prevalent direction of the wind is westerly."—Pages 243 and 264.

Here we see that the vapour which is brought from the wide expanse of the southern ocean is condensed in this locality and warms it.

There is a certain degree of resemblance between these islands in the southern Ocean and Iceland in the north Atlantic. Both have currents of cold water flowing on them from Polar regions. The Falkland Islands, as well as Tierra del Fuego, are wet, and, for their latitude, warm in the winter. The cold Polar oceanic current from the Arctic regions brings large quantities of ice to the north side of Iceland, yet that island, extending from 63° to 66° north, is very warm for its position. But it has either copious rains, brought from the Atlantic, or heavy falls of snow. Its winter temperature is therefore high. The coast of Norway, evidently from the same causes, partakes of the winter climate of Iceland. Dillon says, in his Winter in Lapland, when at Bosekope on the Alten Fiord, "It was the 26th January, yet no ice was visible in the bay." And when writing of Iceland he says, "In Quebec the mercury fell 32° below zero, and although I have never seen it, by many degrees, so low in Iceland, I can remember many occasions when

the cold has appeared to be more intense. I account for this difference by the severity of the weather in Canada and the awful gales that never ceased to blow in Iceland. Often have I been obliged to turn back, finding it useless to urge my horse against the wind. In the course of an hour the whole front of the house, up to the roof, was snowed up."—Page 167. There is also another point of resemblance. Tierra del Fuego is in a colder latitude than eastern Patagonia, which is both dry and cold in the winter; and Labrador and Canada are also dry and have winters much colder than those of Iceland. The vapour which warms the parts in the colder latitudes, in both hemispheres, does not reach the parts which are in the warmer latitudes, and the latter are, therefore, without the warming influence of that condensation. These two localities in opposite hemispheres furnish evidence that oceanic currents have but small direct effect on climate, and that condensation of atmospheric vapour has great effect. Iceland, there is no doubt, is made warm in the winter by condensation of vapour often followed by congelation, and there is good reason to conclude that the same influences affect the British Islands and other parts of north-western Europe.

It is, however, quite possible that water from the Northern Atlantic is, to some extent, taken towards the Polar regions in the winter. Winds from the south are there frequent, blowing as far as Spitzbergen and Nova Zembla, and, by pressure on the water over which they pass, these winds may take some water with them from the south; but it is quite unnecessary, and certainly is unwarranted, to assume that the dynamical force of the Gulf-stream sends warm water to this remote part, say, from 40° to 70° or 80° of latitude! Products of warm climates, it is well known, have been occasionally floated to the shores of northern countries; but it has been assumed, and not proved by reasonable evidence, that they have been brought by the Gulf-stream. It is, however, far more likely that they are taken by wind and the surface-currents produced directly by it. A wind passing over water acts on any object that is floating on the surface, and carries it forward more rapidly than the water flows. To the action of the wind, or to the water put in motion by it, or to both, we may then attribute the floating of southern products to northern parts of the Atlantic.

Condensation of vapour to a large extent takes place among the hills and mountains of Ireland, Scotland, and England, as may be inferred from the falls of rain. The winter rains are heavy against the Kerry and other mountains of Ireland. In the Isle of Skye, to the west of Scotland, at Cuchullin Lodge, 141 inches of rain fell from the 1st of August, 1850, to the same date in 1851. In January alone there fell 27·7 inches. In many parts of Cumberland above 100 inches have been registered in the year; and in

one part, 189 inches! Along the western sides of all the mountains of the islands heavy rains fall, especially in the latter half of the year extending into winter. Condensation in these parts is, therefore, very abundant, making the atmosphere misty, rainy, and warm when tested by the thermometer.

The Pyrenees, the Alps, and the German, as well as the Scandinavian mountains, have their degrees of influence in condensing vapours brought from the Atlantic, and by the vacua created about them, drawing further supplies to render western Europe, especially in the parts near the sea, warm in the winter. Each locality in this part of the world is, in the cold season, warmed in proportion to the amount of vapour condensed in it. The thickly shrouded and drizzling atmosphere of the western islands of Scotland in latitude 58°, constantly giving out heat of condensation, is warmer than that of London in the winter; but, then, six-times the quantity of rain has been known to fall in the former place that descended in the latter; and more rain has fallen in the Isle of Skye in the month of January, than fell in London or Paris in the whole year.

From these various facts and considerations we are, then, warranted in coming to the conclusion that the belief of the mild winter climate of the British islands, and of the seaboard of north-western Europe being due to the Gulf-stream, is an error; and that the superior warmth of the part is attributable to condensation of vapour—such as evidently warms, in the winter, Cape Horn, Tierra del Fuego, Western Patagonia, and various other parts distant from the Equator.

Shortly after this paper was read to the Manchester Literary and Philosophical Society, there appeared in the 'Manchester Guardian' newspaper the following Meteorological Report from Mr. J. L. Casartelli:—

	Temperature in Shade by Self-registering Thermometer.			Difference between Wet and Dry Thermometer at 2 P.M.	Direction of Wind at Noon.	Daily fall of Rain.	Weather.
	Maximum.	Minimum.	Difference.				
1855.							
Dec. 10	35°	29°	6°	4°	N.W.	..	Fair and frosty.
,, 11	31	25	6	3	N.W.	..	Ditto.
,, 12	32	25	7	3	N.W.	..	Ditto.
,, 13	32	21	11	3	N.W.	..	Ditto.
Mean	32·50	25	7·50	3·25	N.W.	..	Ditto.
On the 14th of December a change of weather took place as follows:—							
Dec. 14	45	30	15	1	N.W.	0·10	Cloudy.

Here we have a great change of temperature without any alteration in the direction from which the wind came. The great change which took place was evidently in the quantity of vapour in the air. The minimum of the dry thermometer had been a mean of 25°, and the wet-bulb thermometer was 21°·75, showing a difference of 3°·25 of dryness. But on the 14th the minimum of the dry thermometer rose from 25° to 30°, and the wet-bulb rose from 21°·75 to 29°; showing that on the 14th there was much more vapour in the air than there had been during the previous four days; and an effect of this increase in the quantity of vapour was experienced in the fall of one-tenth of an inch of rain on that day. The maximum temperature on the 13th was 32°, from which it rose the next day to 45°, though the wind continued in the same direction. What then could raise the maximum temperature 13° in one day? It could not be the air, because it came from the same cool quarter that it had come during the previous four days. It could not be the direct action of the solar rays, as we see that the sky was cloudy, although it had previously been clear. It could, therefore, only be the condensation of the more abundant vapour to a sufficient extent to warm the gases, and raise their temperature 13°: and this warming seems to have produced an ascending current, which showered down a tenth of an inch of rain.

Similar risings of temperature are experienced in other places. In the London 'Spectator' of Dec. 29, 1855, is the following article:—

"The great change of temperature that occurred between Saturday and Sunday was not confined to London. Saturday it was intensely cold. Next morning, June seemed to have elbowed out December, and the warmth of the atmosphere out of doors oddly contrasted with the chill within. . . . It is stated, that at Paris." . . . "By one of those violent changes to which the Parisian climate is so peculiarly liable, we were yesterday suffering from the most poignant cold, and are to-day steeped in unnatural humidity and warmth. The aspect of the city yesterday (the 22nd) was of a most Muscovite description. The cold had descended to nearly 11° below freezing, and, in consequence of the excessive dryness of the atmosphere and the brilliant sunshine, though seemingly devoid of all warmth, the dust from the macadamized streets lay almost as thick, and rose in clouds as offensively as in the dog-days. Everything freezable was fast bound by the icy fangs of as keen a wind as ever blew across the Place de la Concorde, whose basins were converted into solid blocks of ice clear as glass and many inches thick. The moon rose upon an equally stringent state of things, and even some time after midnight no symptoms of a change were visible. At 8 A.M. this morning, if not earlier, a soft rain was falling fast, and the change in the temperature could be hardly less than 30°."

Are not such cases as these proofs that aqueous vapour is a most important agent in conveying heat, which, when liberated from its chemical union with water, extensively modifies climate? To such an agent we may attribute the generally mild winter-climate of the British islands.

X.—*Remarks on Serpent Island.* By CAPTAIN T. SPRATT, C.B., H.M.S. Medina.

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Read, June 8, 1857.

See Admiralty Map of 1857.

THIS little island, independent of the question of right, formerly in dispute, has several points of interest peculiar to it. First, from its local position, as the eye of the Danube; and also from being the only real island, small as it is, in the Black Sea, deserving the appellation.

Nature thus seems to have placed it there on purpose to be a beacon or shield for the approach to the low shore and shallows that extend from the mouths of this great European river, the delta of which has a sea-coast of the same low character of more than 50 miles in extent, and nowhere 2 feet above the sea.

By its mineralogical character also it is peculiar, since it cannot be claimed or be said to be a part of either the Dobrutcha or Bessarabia from any identity of their approximate coasts. Neither can the Danube claim it as a creation from its deposits. The composition or geological character of its rocks show that it is a fragment of the older group of strata which form the mountains surrounding the south-western division of the Black Sea, Bulgaria, &c.; and it thus appears to be an outlying peak or fragment of the schistose group of rocks that occur in the north part of the Dobrutcha, near Besh Tepeh and Toultcha; for it is composed of siliceous strata, containing large crystals of quartz, and passes sometimes into red jasper. The strata are separated by thin bands of friable shale, and attain a thickness of nearly 200 feet, their dip being from 10° to 20° to the E., and the height of the island 130 feet above the sea.

From this description of the nature of the island it is thus evident that it has no connexion with the low, flat country of Bessarabia, as I have heard it often stated. For this coast, and also the interior of the country, as far as could be seen from the Medina's masthead, anchored off it, appears not to be 20 feet above the sea anywhere, and to be composed of the earthy marl, which forms the surface of the level steppe generally. Indeed, the coast of Bessarabia to the N. of Serpent Island is hardly above